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CubeSat Technical Interchange Meeting
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Agenda

- DSN Uplink Swap and 4 spacecraft MSPA status
- High level summary of CubeSat Mission Status as August
  - Bio Sentinel
  - Lunar Flashlight
  - Lunar IceCube
  - NEA Scout
  - LunaH MAP
  - CuSP
- Cubequest that want to potentially use the DSN
  - Alpha CubeSat, Xtraordinary Innovative Space Partnerships, Inc.
  - Heimdallr, Ragnarok Industries, Inc
  - Team Miles, Fluid & Reason LLC
  - Cislunar Explorers, Cornell University
  - MIT KitCube, Massachusetts Institute of Technology
  - SEDS, University of California- San Diego
  - G.O.A.T.S., Worchester Polytechnic Institute
  - CU-E3, University of Colorado – Boulder

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Agenda

- Briefly revisit again DSN Checklist
  - Note that for Cubequest Challengers, the suggested time line will be condensed as appropriate, and will depend on if the challengers uses DSN for operations and or only validation.
  - Questions on suggested checklist?
- First 36 hours after separation for each CubeSat
  - Specifically focusing on need DSN service especially CubeSat after separation station view period
  - Request information by target date of 29 September 2016
- Open Forum

DSN Check list

(To be used as a Guide only. Note Cubequest challengers schedule will condensed as appropriate)

- **Launch minus 2 years: DSN Task Plan**
  - DSN User Loading Profile (ULP) provided by Mission
  - DSN Aperture Fee (Attributed cost only, not paid by Mission) developed together by Mission and MIM
  - DSN Tracking Telemetry & Command (TT&C) Costs provided by MIM
  - DSN MIM Costs provided by MIM
  - RF Compatibility costs provided by MIM
  - Communication Line (data/voice interface to JPL) cost if applicable provided by MIM
- **2 years out: Frequency Spectrum License submission (submitted by Mission, with DSN Spectrum office assistance dependent upon frequency band – DSN or Near Earth?)**
  - Spacecraft Trajectory information provided by Mission Navigation
  - Ground Stations that possibly may support provided by Mission
    - (recommend including Morehead State 21-meter antenna)

DSN Check list

(To be used as a Guide only. Note Cubequest challengers schedule will condensed as appropriate)

- **2 years out: Spacecraft ID** (DSN MIM can coordinate request)
  - CCSDS Spacecraft ID request
    - Reference http://sanaregistry.org/r/spacecraftid/spacecraftid.html
  - CCSDS version number
    - Reference CCSDS 320.0-B-6 Blue Book
    - Recommend version 1 (version 2 acceptable)
  - DSN Spacecraft ID
    - Reference DSN Doc 8201-13 Ops-6-21
- **2 years to 1 year: out DSN Service Agreement** (DSA) developed together by Mission and MIM
  - Draft DSA at Preliminary Design Review (PDR)
    - Includes Spacecraft Telecommunication parameters
    - Includes selection of DSN services
    - Includes DSN Costing
  - Final DSA prior to Critical Design Review (CDR)

DSN Check list

(To be used as a Guide only. Note Cubequest challengers schedule will condensed as appropriate)

- **2 years to 1 year out: reserve DSN Compatibility time with the DSN**
  - Input provided by Mission to the MIM who will negotiated resources as appropriate
    - With those using JPL IRIS Radio, this depends on Radio Delivery schedule. Looking around February 2017 time frame.
- **1 year out DSN Operations Interface Control Document (OICD)**
  - Need Mission Flight to Ground ICD (FGICD) or equivalent for DSN OICD input
  - Finalization of Mission interface to DSN services
    - Final selection of interface for tracking data
    - Final selection by Mission of what entity is doing scheduling
- **1 year to 6 months out, Mission Operations Center (MOC) available to interface with the DSN for data flows**
  - Communication lines in place for data flows (data/voice), this is worked between the MIM and the Mission
  - Project Scheduling representative start working with DSN for scheduling data flows, and DSN support request

DSN Check list

(To be used as a Guide only. Note Cubequest challengers schedule will condensed as appropriate)

- **1 year to 6 months out RF Compatibility test**
  - DSN RF Compatibility Information sheet filed out by Mission
  - Mission provide RF Compatibility test plan
  - Mission provide files for commands and telemetry to DSN
    - Used for preparing DTF-21 and DSN configuration tables also may be used for GDS and MOS data flows
  - DSN provide RF Compatibility test plan
  - End to End data flow with Mission Operations Center (MOC) and DSN included during this RF compatibility test period
  - DSN Compatibility test results test results released 30 calendars for signature after test completion.

DSN Check list

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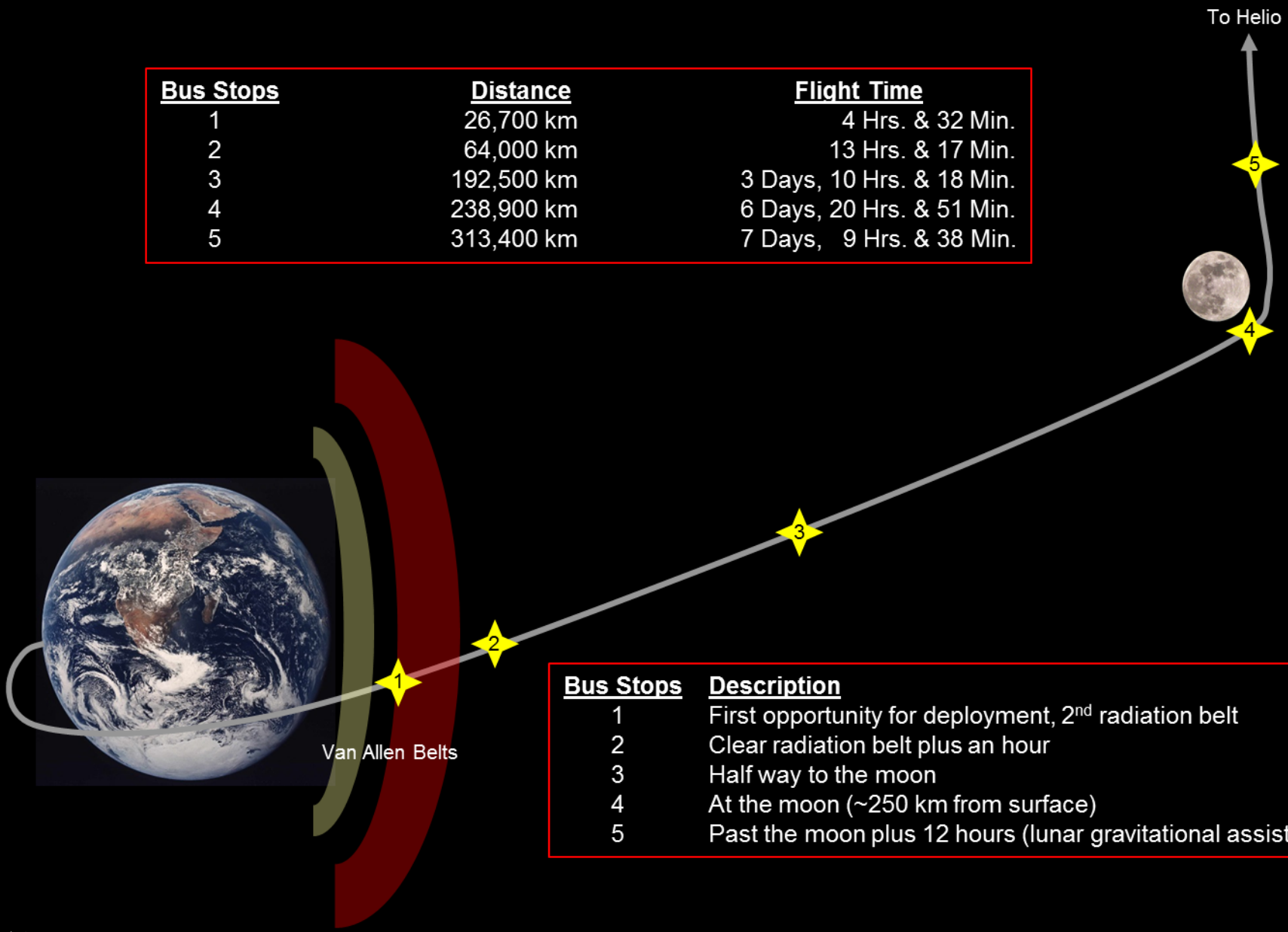
- **5 months out start of Ground Data System (GDS) and Mission Operation Support (MOS) tests**
  - Usually done after DSN RF Compatibility test which includes the End to End data flow
  - Mission provided GDS test plan and requirements
    - Usually First tests will be with DSN DTF-21 followed by GDS tests with actual DSN stations
  - Mission GDS Schedule inputs for DSN Station tests about 1-2 months of starting GDS and MOS tests
- **1 month out launch rehearsal**
  - Submit schedule request to DSN for rehearsal about 2-3 months out
  - About 2 months out submit to DSN rehearsal plan (draft)
- **1 month out DSN Small Sat Readiness Review (SSRR) at JPL**
  - This is a DSN Peer review for readiness of the DSN to support launch/first acquisition of spacecraft

Deployment “Bus Stops”

Bus Stops	Distance	Flight Time
1	26,700 km	4 Hrs. & 32 Min.
2	64,000 km	13 Hrs. & 17 Min.
3	192,500 km	3 Days, 10 Hrs. & 18 Min.
4	238,900 km	6 Days, 20 Hrs. & 51 Min.
5	313,400 km	7 Days, 9 Hrs. & 38 Min.



Bus Stops	Description
1	First opportunity for deployment, 2nd radiation belt
2	Clear radiation belt plus an hour
3	Half way to the moon
4	At the moon (~250 km from surface)
5	Past the moon plus 12 hours (lunar gravitational assist)

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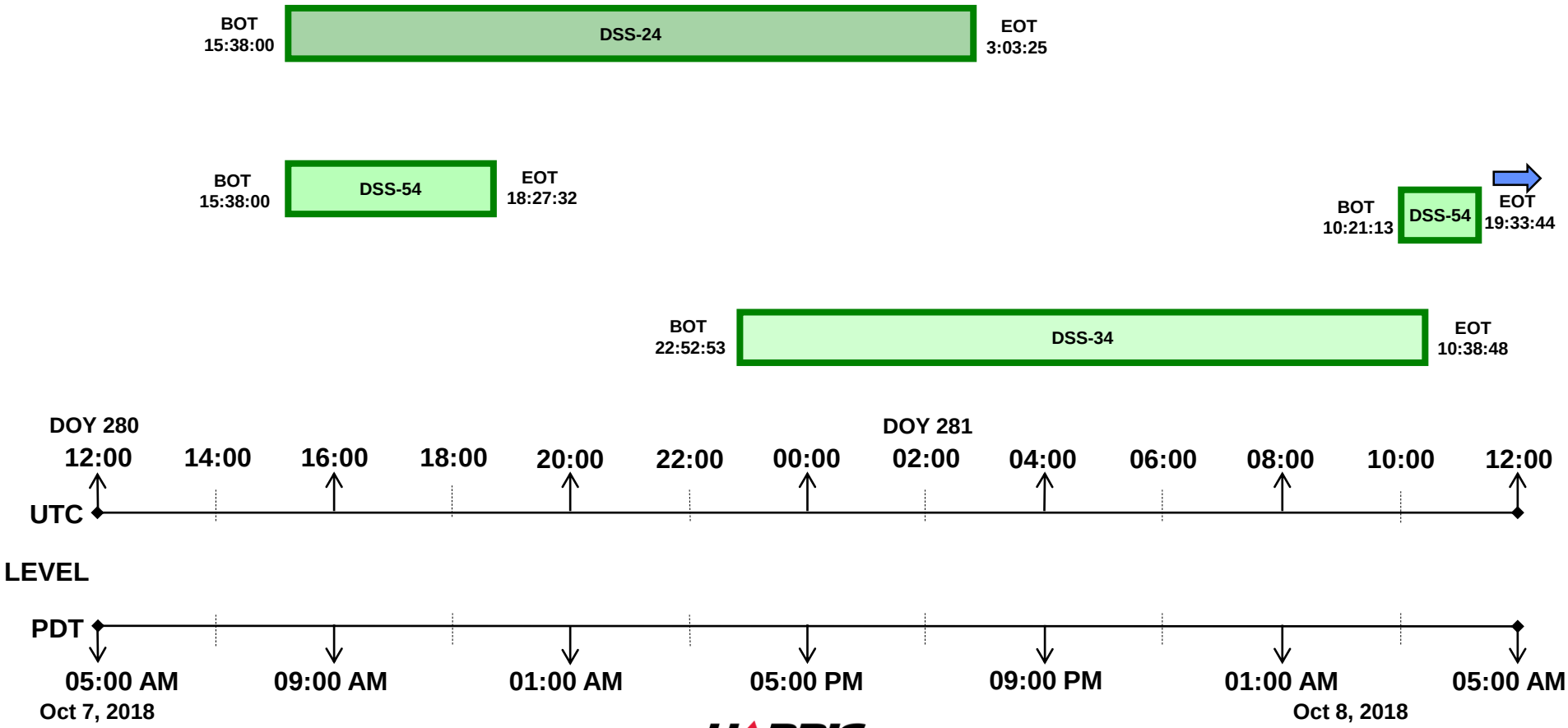
Separation of Payloads Time Line

- **Bus Stop 1 about 4.5 hours after launch**
  - **Argo Moon**
  - **Bio Sentinel**
  - **Lunar Flashlight**
  - **Lunar IceCube**
  - **NEA Scout**
  - **Cube Quest #1 (DSN Support TBD)**
  - **CubeQuest #2 (DSN Support TBD)**

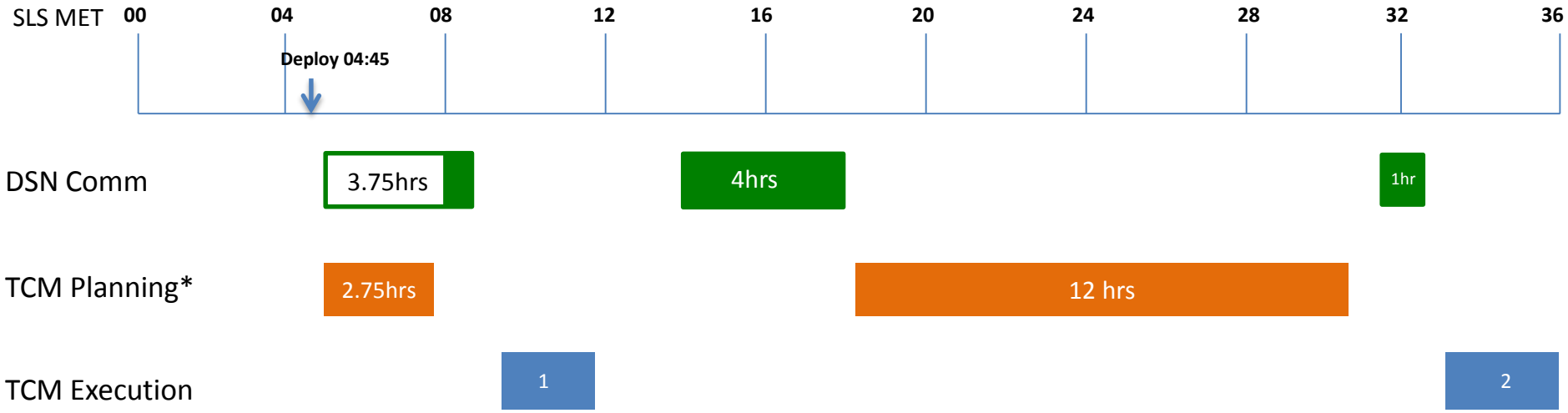
- **Bus Stop 2 about 13.25 hours after launch (note SkyFire will not use DSN)**
  - **Cube Quest #3 (DSN Support TBD)**
  - **LunaH Map**
  - **SLSLIM**
  - **Equuleus**
- **Bus Stop 3 about 3 days 10 hours after Launch**
  - **CuSP**

LunH-Map
DSN Operations

First Stations View based on LunH-Map view periods
Based on Interim Trajectory from Secondary Payload Users Group 7 Oct 2018 Launch



NEA Scout Draft First 36 Hours as example



* TCM-1 requires receipt of ICPS State Vector by 05:00

2-way Comm

- Information Requested for DSN services by Target date 29 Sept 2016
  - Down Link only for Spacecraft health and safety
  - 2-Way DSN Uplink for coherent Doppler
  - Uplink for Critical Commanding
  - Other?

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References

BACK UP SLIDES

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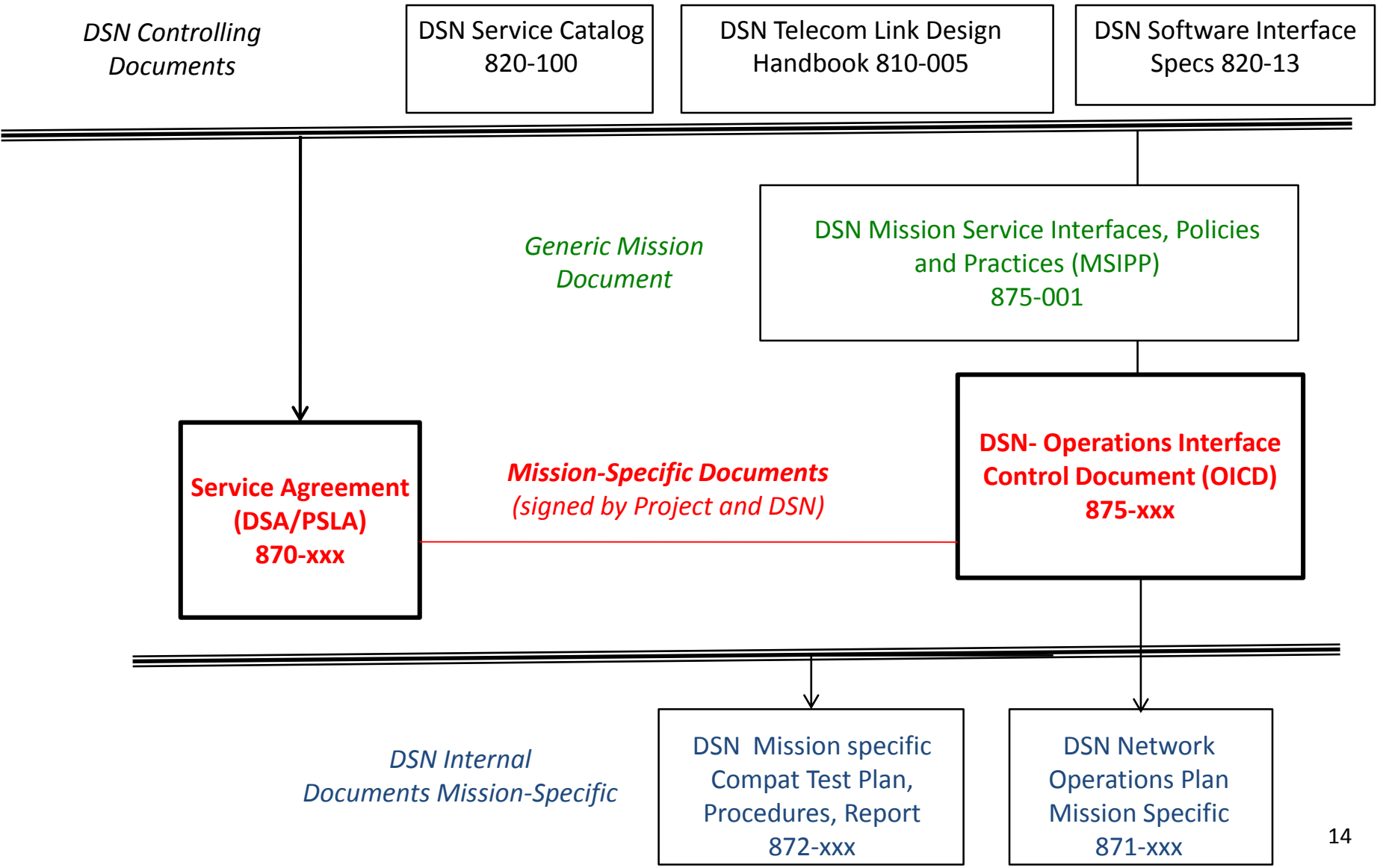
DSN Mission Interface Document Tree



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Key Personnel

- **Mission Interface Manager (MIM)**
  - the mission's agent to optimize DSN technical support and align customer service request with DSN standard services
- **Project Data System Engineer (PDSE)**
  - DSN processing lead for data delivery
- **Network Operations Project Engineer (NOPE)**
  - operational lead for DSN support
  - supported by team of operators, analysts (NOA), engineers (CDE, OE)
- **Mission Manager**
  - interacts with DSN to prepare and execute telecomm
- **Mission Scheduler**
  - the mission's agent to plan provide inputs and negotiate DSN tracking schedule
- **Mission Navigation**
  - Navigation that interact with DSN for delivering SPK (type 13) files for DSN support products (view periods, frequency predictions, antenna pointing)

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Important References

- **DSN Commitments Office Website**
  - http://deepspace.jpl.nasa.gov/advmiss/index.html
- **DSN Mission Service Interfaces, Polices, and Practices (MSIPP)** (875-0001)
  - https://pdms.jpl.nasa.gov/cmtools/DocProperties.aspx?objid=ydvnI2eent001sum70a--M5Y
- **DSN Services Catalog** (820-100)
  - http://deepspace.jpl.nasa.gov/advmiss/docs/DNS_Service_Catalog_820-100-E.pdf
- **DSN Telecommunications Link Design Handbook** (810-005)
  - http://deepspace.jpl.nasa.gov/dsndocs/810-005/index.cfm
- **DSN External Interface Specification** (820-013)
  - https://jaguar.jpl.nasa.gov/